POPULATION STUDY OF JAVAN GREEN PEAFOWL (*Pavo muticus muticus* Linneaus 1758) WITH THREE DIFFERENT METHODS IN BALURAN NATIONAL PARK, EAST JAVA INDONESIA

(*Studi Populasi Merak Hijau* (*Pavo muticus muticus* Linneaus *1758*) *Menggunakan Tiga Metode Yang Berbeda Di Taman Nasional Baluran, Jawa Timur, Indonesia*)

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ABSTRACT

The green peafowl (*Pavo muticus*) has been nominated as a globally threatened bird species (ICBP). It is protected bird in Indonesia and a rare species as mentioned in the red data book (IUCN). The present distribution of the bird in Java is irregular and locally. A few information about the bird population and the data in many cases are not available. Research was conducted in Baluran national park, East Java. It was aimed to obtaining the case of censusing method, population size, structure and mx ratio of Java green peafowl. Three different methods were used: call count transect method, consentration count and capture mark recapture. Call count method with transect lines ir appropriate on censusing of the b i Green peafowl population from sample area indicating in relatively better related to the number (118 birds in 1 200 ha). However, population structure was dominated by adult bird 70% - 80%. The bird mx ratio was 1 male : 4 females, indicated that bird lived in polygamous system.

Key words : Java green peafowl, census method, population, Baluran national park

INTRODUCTION

According to Hoyo *et al.* (1994) and Delacour (1977), green peafowl (Paw *muticus*) has tree subspecies; *Pavo muticus imperator* (Delacour, 1949), *Pavo muticus spicifer* (Shaw & Nodder, 1804) and *Pavo muticus muticus* (Linneaus, 1758). The green peafowl range covers a large area, but in most of its range the bird is distributed patchily and locally and probably extinct in some places, e.g. Northeast India, Bangladesh and Malaysia (Johnsgard, 1986).

Hoyo *et al.* (1994) mentioned that *Pavo muticus spicifer* is distributed from Northeast India and Southeast Bangladesh to Northwest Burma (probably extinct), meanwhile *Pavo muticus imperator* is distributed patchily in South of Burma to Isthmus of Kra and in East through Thailand to South China, Laos and Vietnam. Pavo *muticus muticus* is distributed nowadays only locally in Java and already extinct in Malaysia Peninsular.

Some confusion exists about the status of green peafowl in Jaw. It is reported only restricted to a few isolated reserves. (Johnsgard, 1986 and Collar & Andrew 1988). Van Balen *et al.* (1991) reported *the* distribution of green peafowl in Java, where the bird has been recorded in historical time and where the recent observation has been made. They did not mentioned total population of green peafowl in Java, but they stated the population in some places quite good.

In general King *et al.* (1980) described the habitat of green peafowl: *open* forest, secondary forest, riverine forest and-forest edge. According to MacKinnon (1988), the peafowl habitats are composed of open forest with shrubs and bushes which are preferred. Nowadays, possible habitat to support this bird in Java are forest reserve (National Park, Game Reserve, Nature Reserve, Protected Forest) and teak plantation.

This paper deals about number, age structure, and sex ratio. An intensive study compared several census methods were used.

STUDY AREA

Baluran national park covers an area of about 25 000 ha. Baluran has a typical monsoon climate with a long *dry* season. This climate is heavily influenced by the southeast wind during the period of April to October, with less precipitation. The average dry period covers about 7-8 months *of* the year. The annual precipitation ranges from 900 to 1 600 mm per year (FAO, 1977).

Six type of vegetation have developed in this park: monsoon forest, savanna, beech forest, mangrove, submontain forest & evergreen forest and swampy areas (Partomihardja, 1989). Base on vegetation type was selected: monsoon forest, savanna, beach forest and ecotone between them as sample area.

Intensive study was focused at Bekol resort from August 1994 to February 1995. Sample area was about 1 200 ha with 4 km length and 3 km width, which savanna covered of about 40% (480 ha), monsoon forest 45% (540 ha) and beach forest 15% (180 ha). The sample area was boundaries, from Curah Udang-Bekol to the South until Hectometer (HM) 85 to the East near Popongan to the North until Bama and Kalitopo-Curah Udang to the West close to Bekol.

For bird censusing was made six transect lines named Tobat (Kalitopo-Sumberbatu), Curud (Curah Udang), HM 120, HM 114, HM 105 and HM 95. Tobat transect for length of about 4 km through vegetation type bordered with savanna-beach forest-monsoon forest. HM 120 and HM 114 transect with 3 km length in each transect covered by savanna, meanwhile Curud, HM 105 and HM 95 in each length of 3 km mostly covered by monsoon forest. In each transect was signed every 100 m distance.

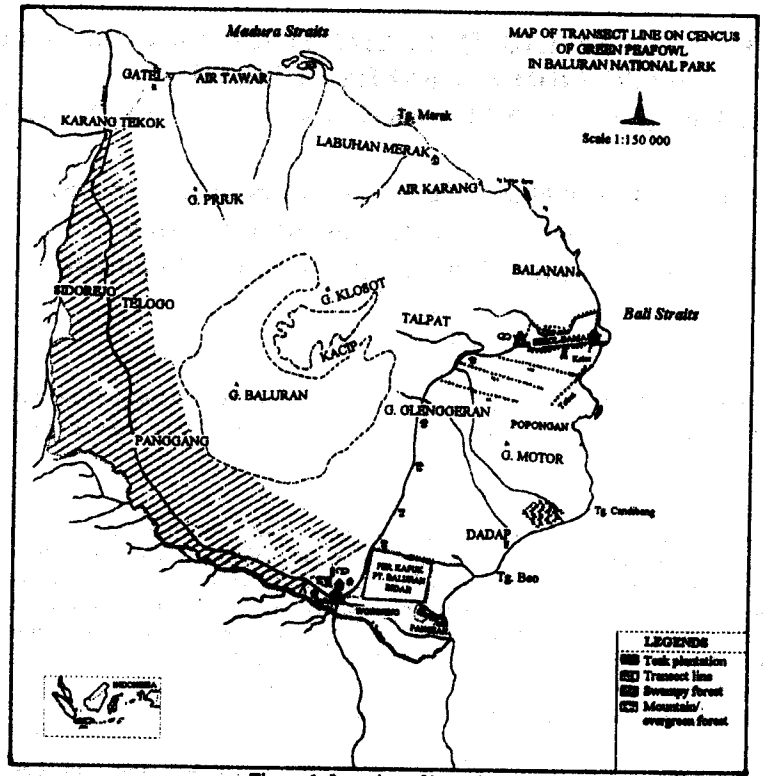

Figure 1. Location of intensive study

METHODS

The census was done by transect call count method and it was carried out for 3 months (Nov 1994 to Jan 1995). Each month with 10 days observation continued in each transect and it was done simultaneously. The census started every morning at 5.00 and lasted until 8.00 a. m. The six observers went through the transect route. The walking speed was about one hour per km in each transect. The counting of individual numbers was based on the calling of green peafowl in fixed area (1 200 ha). and direct visual observation of the bird during censusing. Each calling of a green peafowl was recorded the type and number of calls, the time, and direction from observers to birds. After the census, the observers came together to make corrections to avoid double counting. The population data taken from the census was analyzed with statistical average and the confident limit of the individual number in each transect, month and total transect & month by use of the formula as follow:

$$P = x \pm t\,\mathrm{SE}$$

where

P = population (total number individual in each transect or sample area)
X = total average number in each transect or sample area
SE = standard error in each transect or sample area
t = t student table on number of sample and a = 0.05

To know influence of vegetation type to the bird abundance analysis of variance and Duncan's Multiple Range Test was used. The test was done by SAS (Statistical Analysis System).

Besides those census method was used also concentration count for compared study . During the dry season green peafowls visited water hole every day. Three water holes were presented in the sample area became main places for observed bird with this method. Every peafowl comes to water hole was recorded: number, sex, age (adult or sub-adult) and time. To count the population was used statistical average each water hole with same formula as mentioned at call count method.

Another counting also was used modified from capture mark recapture method. For catch the bird 5.00 units of automatic snare trap was used. The traps were situated certain places where the peafowl gathered such as near water hole, below fruiting trees and close to roosting tree. The peafowl was caught than given a tag with pieces of coloured plastic pipe was placed at back of the bird (rucksack form), and they were measured before releasing. Number of bird was counted based on data taken from concentration count. In this method was modified in recapture activities. Recapture means observation or recorded on tag birds in the sample area, because in the field to catch again (recapture) tag birds very difficult. The formula was used as follow:

$$P = \frac{\mathrm{Txp}}{t}$$

$$SE = P\sqrt{\left\{\frac{(P-T)(P-p)}{Tp(P-1)}\right\}}$$

Where
P = population size
T = number of birds were caught and given tag
p = number of birds were recorded on second (after released tag bird) observation
t = number of tag birds were recorded on second observation
SE = standard error

RESULTS

Population size with call count method

The individual number of green peafowls was counted from call count method in every transect showed that the total average number of individuals in sample area was 131.0 ± 12.5 birds in November 1994; in December 1994 there were 136.7 ± 9.1 birds, but in January 1995 the number was significantly lower at 85.6 ± 7.8 birds. The total average individual number of green peafowls from the sample area with range was 118± 9.8 birds.

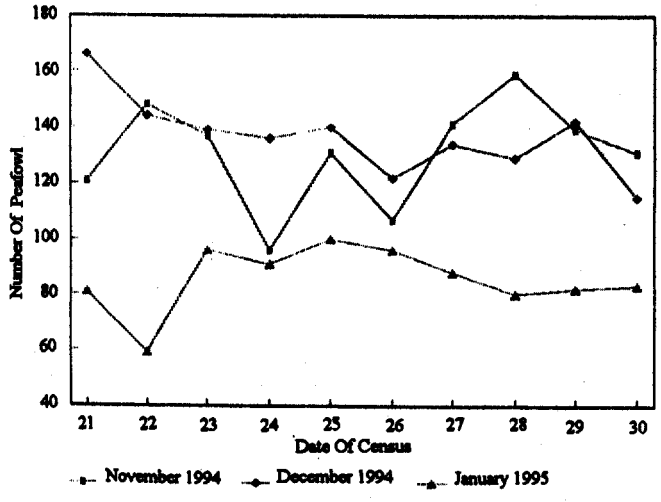

Figure 2. Fluctuation of the green peafowl number from November'94 until January'95 in Baluran national park.

The average population density in the sample area was 10 birds per km^2. In savanna (about 480 ha), the bird density was 6 birds per km^2 and in the monsoon forest (about 540 ha) it was 16 birds per km^2. However in the border areas like Tobat transect, the bird density could not be estimated because it was too difficult to measure this large area.

As shown in Figure 2, the individual number fluctuated. According to the time of census and the habitat type, the average individual number varied in month and transect. The fluctuation number from month to month is due to the different on seasons. It is related to the breeding season of the bird. The variation of the average individual number, however, is caused also by different composition and structure of vegetation in the transect.

Every transect shows different numbers of individuals (Table 1). In December'94, the Tobat (Kalitopo-Sumberbatu) transect had an average of about 22.0 birds. The average individual number in Curud (Curah Udang) transect was 20.0 birds, meanwhile in HM 120 it was 12.4 birds and in HM 114 it was 18.1 birds. The highest average number of individuals was found in HM 95 and HM 105 transect were 30.8 birds and 33.4 birds.

Table 1. The average individual number of green peafowl in the sample area

Transect	Average Individual Number In Each Month					
	Nov'94	t SE	Dec'94	t SE	Jan'95	t SE
Tobat	20.2	3.6	22.0	2,5	12.5	1.6
Curud	30.6	4.9	20.0	3.6	15.4	3.6
HM 120	11.4	3.1	12.4	2.0	19.0	2.8
HM 114	16.8	1.8	18.1	2.0	9.5	1.3
HM 105	23.9	4.5	30.8	4.5	15.5	3.1
HM 95	28.1	4.2	33.4	3.9	13.7	2.5

Note : was derived from Appendix 1.
$T(\alpha\ n) = t_{(0.05,\ 10)}$ 2.228

Variance analysis of the transect and Duncan's Multiple Range Test showed that birds abundance differ between transect and time (month) of census as shown at Table 2. Based on Duncan's Multiple Range Test it was shown on grouping bird abundance according to transect, that transect 5,6 and 2 HM 105, HM 95 and Curud) had relative the same level. Transect 3 and 4 (HM 120 and HM 114) had also the same level of peafowl abundance. But transect 1 (Tobat) showed a different level of bird number with the others.

Table 2. Analysis of variance procedure Duncan's Multiple Range Test for variable: Peafowl by class Transect and Month

Duncan Grouping	Mean	N	Transect
A	25.067	30	6
A	23.400	30	5
A	22.000	30	2
B	18.233	30	1
C	14.800	30	4
C	14.267	30	3
Duncan Grouping	**Mean**	**N**	**Transect**
A	22.783	60	2
A	21.833	60	1
B	14.267	60	3

Note: Mean with the same letter are not significantly different
Transect 1 = Tobat transect — Transect 4 = HM 114 transect
Transect 2 = Curud transect — Transect 5 = HM 105 transect
Transect 3 = HM 120 transect — Transect 6 = HM 95 transect

This phenomenon might be due to different structure and composition of vegetation in that transect. According to the month, the bird abundance was tested in the same manner shown that in month 1 and 2 (Nov and Dec' 94) there was the same level, but different with month 3 (January' 95), The average number of individuals in each month fluctuated, but tended to decrease after December. This case was caused by decreased calling at the end of mating season.

Population size with concentration count

Census with concentration count at three water holes was resulted data as shown at Table 3. From this method resulted

total population of green peafowl in sample area was 54 ± 6.9 birds. At least 90 times observations was made at the water holes recorded green peafowl visited there. The result was lowest than call count method and modified capture mark recapture method.

Table 3. Number of green peafowl drinking at different water holes during the dry season

Location	Male	Female	Adult	Young (sub-adult)
Bekol	4	20	16	8
Bama	3	9	9	3
Kelor	4	14	13	5
Total	11	43	38	16

Note: from 90 observations were done

Population size from modified of capture mark recapture method

From five location of catching were caught 30 birds consist of 5 males and 25 females (Table 4). One female bird got accident finally dead because too late took the birds from traps and the other female was tagged with a transmitter radio tracking.

Table 4. Number male and female of green peafowl which were caught Catching

Catching Location	Male	Female	Adult	Young (sub-adult)
Bama	-	7	6	1
Bekol	3	7	7	3
HM 110-108	1	5	6	-
HM 20 Barna-Bekol	1	1	2	-
HM 15 Bama-Bekol	-	5	4	1
Total	5	25	25	5

Based on second observation (recapture modified) at three water holes 54 birds were recorded and from that number 9 peafowls as tag bird. Total number of tag birds was released 29 birds. Total of green peafowl in area sample from modified capture mark recapture method was 174 ± 88 birds. The result is highest than the other census but the standard error showed quite wide range.

Age structure and sex ratio

The census data from call count method it was difficult to determine the sex ratio and age structure of green peafowl in the sample area, because it could not be differentiated by calling between males or females and adult or sub-adult birds. Thus another method must be used to find out something about the sex ratio and the population age structure.

If the estimation of the sex ratio can be taken from the number of caught birds (Table 3), it was 1 : 5. These data indicate also age structure of the population, which is presented by 25 adult (83.33%) and 5 young birds (16.67%). Another possibility of estimation is given by numerous observations at several water holes, from August '94 to mid of December '94. When the green peafowls came for drinking and stood there for longer time the sex of the birds could easily be determined, also the age structure of peafowl which drink could be estimated. From these records the sex ratio was 1 male: 3.9 females and the age structure, however can be estimated of 71.43% adult and 28.57% sub-adult birds. Based on the water hole observations and catching data, the population of green peafowl tended to have the same sex ratio of 1 male : 4 or 5 females and the population structure to have 70 % - 80 % adult birds.

DISCUSSION

Compared census results shown that the higher population counted by modified capture mark recapture method and lowest with concentration count. At the both methods were found some weaknesses. It is difficult to fix the area sample for counting with modified capture mark recapture method because researcher has got experience from observation on a female bird was given a tag YRY (yellow, red, yellow mark) and transmitter radio tracking. Only in few days (2-3 days) the bird moved about 4 km outside from observation area (sample area which was given grid). It might influence of the census result if several tag birds outside from sample area. To find tag bird by transect line during at call count census method with transect line is very difficult. In three months observation with this method found only four tag birds. More difficult to recapture the birds because from field observation shown that birds have been caught had experience with the traps, the birds will avoid them (Hernowo, 1995).

Observation on a female tag bird GGG (green, green, green mark) shown that bird visited the water holes every 2 - 3 days. Another observation also was done to sub-adult male with mark GRR (green, red, red) drunk at Bekol water hole every two days (Hernowo, 1995). From this case, non-tag bird visited water-holes may be different individual everyday. The census with concentration method only based on average number bird come to water holes. Result from this method could be lower than actual population, because could not differentiated non-tag bird individually.

Problem of the call count method exists if the birds do not call during census. In these case the census results might be lower than the actual number in the field. Usually included in that categories are chicks and very young birds. If several birds quite frequently change the call type in one series call, it may be confusing during the census. It causes over estimation of population size.

From comparation three methods were used on investigation of peafowl population in sample area call count method with transect line resulted more appropriated than the others.

The determination of population structure had some weaknesses, when counting individual number of green peafowl from the call count method (indirect method). Because the calls sign in several cases can not differentiate the birds sex. To investigate the sex ratio from this method is only relatively clear for adult male during the breeding season, because the adult peacock has a special call. But at any other times of the year it is very difficult to differentiate their calls (Hernowo, 1995).

Undoubtedly look at the bird sex ratio was 1 male : 4 or 5 females that the birds live in a polygamous system. Furthermore

in that ratio show only the ratio between male and female, but it is not describe how many birds actual mature both male and female. The bird composition of about 70% to 80% is adult bird and the rest is young birds (30% - 20%).

From the composition and age structure of green peafowl it is shown that the number of adults dominated, but that the young birds were relatively low in number. Whether this is the natural age structure of a peafowl population or this is the result of a high rate of juvenile mortality remains unknown. Several possibilities influence to that population. These case might be the caused of less successful on the rearing bird until mature due to predation rate, the habitat become less suitable for peafowl and the hunting pressure to the bird. From field observations were found poaching by snare or steal eggs mainly during the breeding season caused problem to the population.

With total number of peafowl about 118 $\pm$ 9.8.birds in 1 200 ha, indicating that the population is relatively high compared with other places in Java.. The highest density was found in the monsoon forest with 16 bird per km^2. In the monsoon forest, the birds seem to have more natural resources such as food, nesting sites, and display area.

According to Johnsgard (1986) and Collar & Andrew (1988), total green peafowl population in East and West Java was estimated at about 250 birds. King and Warren (1988) calculated the peafowl population in Baluran national park (25 000 ha) not more than 200 birds present. Although green peafowl spread most of Baluran national park area, but Pattarutama (1976), Mulyana (1988) and Winarto (1993) mentioned that bird more abundant in Bekol resort. Comparing result of peafowl census from King and Warren (1988) with Hernowo (1995) shows that King and Warren result quite low, because Hernowo found 118 birds in 1 200 ha (Bekol resort).

Hernowo (1995) mentioned that green peafowl population in Baluran national park still have vigoritas because they have nests and rear youngs. Thus in general the population of green peafowl in Baluran national park, might be in better situation than is believed before. Although condition of peafowl population in this park is relatively good, but human influences are mostly caused main problem threatening to the birds such as poaching activities. Conservation efforts do not only protect the peafowl but also to educate people and create increasing their income, because people who live surrounding where the green peafowls are distributed have a low per capita income. Van Balen *et al.* (1991) mentioned perhaps for centuries, that hunting have been the most serious threat to peafowl in Java. The poachers are not only get the birds, but the eggs, chicks and the feathers are taken away. Not only adult birds, but also the chicks are highly price (illegal commodity)

CONCLUSION

Using three different censusing methods have result in different individual number of bird. Call count transect method resulted 118 $\pm$ 9.8 bird and capture mark recapture modified method counted number of bird 174 $\pm$ 88 individuals, meanwhile concentration count method was estimated number of bird about 54 $\pm$ 6.9 individuals.

Some weakness of each method remains such as : Call count transect method cannot estimated population structure, sex ratio, bird does not calling uncounted, the method is depend on call of bird, meanwhile the calling will be influenced by the season (breeding season).

Capture mark recapture modified method is very difficult to define the census area if the bird has large homerange. They can go out side from census area, the consequence will influence on result.

Consentration count method in this case only well done in dry season, because water is limited in certain places, but in rainy season water is available in everywhere. The method is very time consuming because in the whole day must be observed the bird visited in waterhole. Bias will be happen if do not know how many times in every day the bird drink, because the bird cannot be differentiated individually.

Bird sex ratio (1 male : 4 female) has indicated that bird live in polygamous system. Bird population structure 70% - 80% is adult bird and 20% - 30% is uvenil.

Regarding to monitor the peafowl population in Java island using call count transect method should be suggested. Permanent plot on observing the green peafowl population dynamic is important.

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Appendix 1

The Green Peafowl Census in 1200 ha Sample Area In Baluran National Park With Call Count Transect

Date	Number Individual on transect						Total Average S E		
	Tobat	Curud	HM 120	HM 114	HM 105	HM95			
Nov, 21,94	23,0	18,0	8,0	18,0	32,0	22,0	121	20,0	2,9
Nov, 22,94	24,0	44,0	9,0	14,0	36,0	21,0	148	24,0	4,9
Nov, 23,94	23,0	36,0	10,0	18,0	25,0	25,0	137	22,0	3,2
Nov, 24,94	12,0	25,0	7,0	12,0	21,0	19,0	96	16,0	2,5
Nov, 25,94	17,0	33,0	8,0	15,0	20,0	38,0	131	21,0	4,3
Nov, 26,94	10,0	26,0	9,0	15,0	17,0	30,0	107	17,0	3,2
Nov, 27,94	23,0	31,0	17,0	20,0	22,0	28,0	141	23,0	1,9
Nov, 28,94	25,0	38,0	20,0	17,0	28,0	31,0	159	26,0	2,8
Nov, 29,94	24,0	29,0	9,0	20,0	23,0	34,0	139	23,0	3,2
Nov, 30,94	21,0	26,0	17,0	19,0	15,0	33,0	131	21,0	2,5
Total	202,00	306,00	114,00	168,00	239,00	281,00	1310,0		
Average	20,2	30,6	11,4	16,8	23,9	28,1	131,0		
S E	1,6	2,2	1,4	0,8	2,0	1,9	5,6		
Dec, 21,94	18,0	33,0	17,0	22,0	42,0	34,0	166	27,7	3,8
Dec, 22,94	23,0	18,0	11,0	16,0	38,0	38,0	144	24,0	4,3
Dec, 23,94	19,0	20,0	12,0	18,0	35,0	35,0	139	23,2	3,6
Dec, 24,94	17,0	21,0	11,0	22,0	33,0	32,0	136	22,7	3,2
Dec, 25,94	25,0	24,0	14,0	17,0	29,0	31,0	140	23,3	2,5
Dec, 26,94	20,0	17,0	17,0	15,0	28,0	25,0	122	20,3	1,9
Dec, 27,94	23,0	14,0	14,0	18,0	33,0	32,0	134	22,3	3,2
Dec, 28,94	22,0	18,0	11,0	18,0	23,0	37,0	129	21,5	3,2
Dec, 29,94	29,0	19,0	9,0	22,0	20,0	43,0	142	23,7	4,3
Dec, 30,94	24,0	16,0	8,0	13,0	27,0	27,0	115	19,2	3,0
Total	220,0	200,0	124,0	181,0	308,0	334,0	1367,0		
Average	22,0	20,0	12,4	18,1	30,8	33,4	136,7		
S E	1,1	1,6	0,9	0,9	2,0	1,6	4,1		
Jan, 21,95	11,0	13,0	16,0	11,0	16,0	14,0	81	20,0	2,9
Jan, 22,95	10,0	10,0	16,0	8,0	8,0	7,0	59	24,0	4,9
Jan, 23,95	14,0	14,0	21,0	10,0	20,0	17,0	96	22,0	3,2
Jan, 24,95	12,0	19,0	20,0	9,0	13,0	18,0	91	16,0	2,5
Jan, 25,95	12,0	27,0	26,0	9,0	13,0	13,0	100	21,0	4,3
Jan, 26,95	13,0	11,0	25,0	8,0	20,0	19,0	96	17,0	3,2
Jan, 27,95	18,0	10,0	16,0	7,0	22,0	15,0	88	23,0	1,9
Jan, 28,95	13,0	19,0	19,0	8,0	10,0	11,0	80	26,0	2,8
Jan, 29,95	10,0	13,0	20,0	14,0	14,0	11,0	82	23,0	3,2
Jan, 30,95	12,0	18,0	11,0	11,0	19,0	12,0	83	21,0	2,5
Total	125,0	154,0	190,0	95,0	155,0	137,0	856,0		
Average	12,5	15,4	19,0	9,5	15,5	13,7	85,6		
S E	0,7	1,6	1,3	0,6	1,4	1,1	3,5		